

LENA Conversion Foils Using Single-Layer Graphene, Phase II

Completed Technology Project (2017 - 2019)

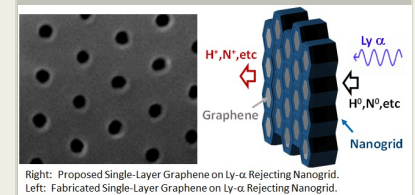


Project Introduction

Implementing graphene foils in existing neutral atom detector designs will increase their angular and energy resolution, and also improve their mass discrimination and usable energy range. Graphene atomic uniformity and low mass density offer natural advantages over amorphous carbon foils in time-of-flight instruments. We expect that Phase II will yield flight-ready prototype foils available for rocket or pathfinder missions with substantial improvements in instrument performance. Graphene foils can also enable improved designs, for instance with lower mass or lower power consumption. Graphene is potentially useful in very low energy neutral atom detection, e.g. $E < 10\text{eV}$. Graphene has advantages over amorphous carbon such as 3X higher optical absorption than amorphous carbon, high infrared crystalline uniformity. Phase I achieved a number of technical "firsts" for graphene and nanohole arrays, including: -the world's largest grid-supported single-layer graphene ($>4\text{cm}^2$) - SLG on nanohole arrays with hole coverage of $>99\%$ -a method for attaching single-layer graphene to mesh without adhesive -bilayer graphene membranes with $>95\%$ coverage on commercial mesh -Lyman alpha blocking of 99.8% using aluminum nanohole arrays Our Phase II effort will continue to improve microgrids, nanogrids and graphene for LENA detectors. In particular, we will

1. Fabricate bilayer graphene (BLG) on microgrids as a better-performing foil for existing LENA instrument designs.
2. Fabricate pristine SLG on nanogrids, extending TOF detectors to $<200\text{eV}$.
3. Investigate surface modification of graphene to enable detection of $<10\text{eV}$ neutral atoms.
4. Make prototype samples for other NASA and non-NASA applications.

Compared with existing foils, our proposed SLG structure reduces scattering, improves low energy signal, and improves energy resolution. The structure reduces the serial losses and increases the effective collection area.



LENA Conversion Foils Using Single-Layer Graphene, Phase II Briefing Chart Image

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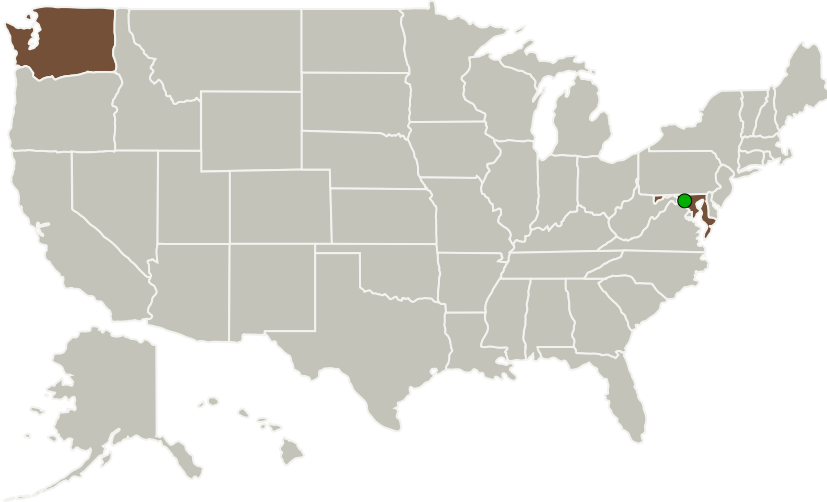
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Luxel Corporation	Lead Organization	Industry Small Disadvantaged Business (SDB)	Friday Harbor, Washington
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland	Washington
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Project Transitions

▶ **April 2017:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Luxel Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

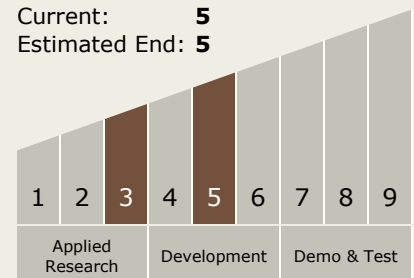
Carlos Torrez

Principal Investigator:

Benjamin Zeiger

Technology Maturity (TRL)

Start: **3**
 Current: **5**
 Estimated End: **5**



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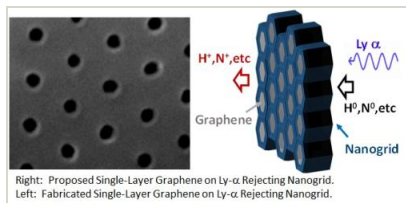


✓ **April 2019:** Closed out

Closeout Documentation:

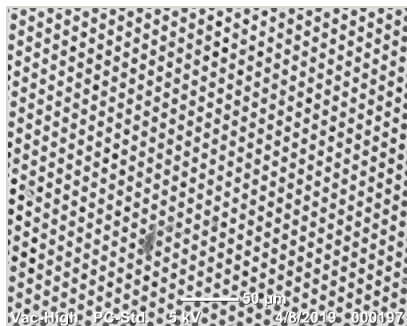
- Final Summary Chart(<https://techport.nasa.gov/file/140936>)

Images



Briefing Chart Image

LENA Conversion Foils Using Single-Layer Graphene, Phase II
Briefing Chart Image
(<https://techport.nasa.gov/image/136738>)



Final Summary Chart Image

LENA Conversion Foils Using Single-Layer Graphene, Phase II
(<https://techport.nasa.gov/image/127188>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.1 Detectors and Focal Planes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System